AN INVESTIGATION OF THE EFFECT OF REPLACING FISH MEAL WITH SOYABEAN MEAL, GROUNDNUT CAKE AND BLOOD MEAL AT VARIED PROPORTION ON GROWTH AND FOOD UTILIZATION OF THE Clarias anguillaris FINGERLINGS FED IN OUTDOOR HAPAS

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ABSTRACT

Fingerlings of *Clarias anguillaris* obtained from a homogenous source through induce breeding and each with a mean weight of 2.8g were stocked in ten hapas each measuring 1.0x1.0m in outdoor concrete tank and were fed for eight (8) weeks.

Results shows that the best growth rate was recorded among fingerlings fed fish meal as the only protein source (TD5) while DT2 containing soyabean, groundnut cake (40%), blood meal as the protein sources came next. The growth rate of fingerlings fed DT2 (40% groundnut cake, 10% soyabean meal and 10% blood meal) was higher than those fed DT4 containing 10% fish meal but lower than those fed DT5 which has fish meal as its sole source of protein (53.0%). Analysis of various growth parameters like SGR, FCR and PER. shows that DT5 was the overall best diet but there was no significant statistical difference in weight gained by fish fed the five diets ($P<0.05$).

INTRODUCTION

Nutrition of pond fishes is one of the major problems of aquaculture in this part of the world. Making quality supplementary feed available to cultured species at appropriate level and time still remain an objective yet to be accomplished. A lot of factors are responsible for this trend. The most important of these factors is that most of the feedstuffs like maize, sorghum, soyabean, groundnut cake and fish meal used in preparing fish pellets face serious competition from man as food in Nigeria. Attempts at looking inward for less useful materials for this purpose has not been very successful.

In nutrition studies, priority is always given to protein requirements, because protein is the single nutrient that is required in the largest quantity for growth, Lovell (1981). Also, since the use of fish meal in fish feed formulation is not cost effective, efforts is now being concentrated at looking inward for plant source of protein in fish diets. This study is one of such efforts.

Realizing that for normal physiological functions of the body which include among other things growth, reproduction and respiration, fish require adequate levels of protein, carbohydrates, water, minerals, lipids and vitamins in their diet, provision was made for these nutrients in the formulated diet (Table 1). According to Lovell and Stickeny (1977)

Table 1: Composition of Experimental Diets and Result of proximate Analysis.

Feedstuff	Dt1	Dt2	Dt3	Dt4	Dt5
Fish meal	-	-	-	10.0	53.0
Soyabean meal	40.0	10.0	25.0	25.0	-
Groundnut cake	10.0	40.0	25.0	15.0	-
Blood meal	10.0	10.0	10,0	10.0	-
Yellow maize	38.0	38.0	38.0	38.0	45.0
Mineral premix	2.0	2.0	2.0	2.00	2.0
Total	100	100	100	100	100
Computed crude protein	34.10	34.10	35.10	35.10	36.30
Proximate Analyisis:					
Crude protein	33.17	32.83	35.08	34.98	35.12
Ash	4.25	4.45	4.45	6.90	17.55
Moisture	28.02	30.77	35.02	35.02	35.02

a deficiency of one or more of these essential nutrients could result in poor performance, stunted growth, disease infection or even death.

As noted by Wilson *et al* (1981) fish do not have a requirement for protein *per se,* but rather requires amino acids that are usually obtained by digestion of protein. The mud fish (*Clarias* spp) requires ten essential amino acids and like other animals does not have a true specific protein requirement but a requirement for a well balanced or essential and non-essential amino acids at each stage of their growth and development. Thus, the quantitative dietary protein requirement could vary with age, size and other factors.

The better balances the protein is in essential amino acids, the lower the total amount of protein required to meet the fish's needs. Poor growth rates were recorded in carp and eel when an essential amino acid was lacking in the diet. Lysine and methionine in particular are very critical because according to Halver (1980) the amino group of lysine can react with non-protein molecules in the feedstuff during processing to form additional compounds which render the lysine biologically unavailable while methionine can be oxidized during the period of processing.

Despite the underdevelopment of aquaculture in Nigeria, a lot of efforts has been made in the area of feed formulation for our local species of fish. It is in the light of this that this study is designed to further boost earlier efforts made at formulating a standard fish feed for the mudfish farmers in Nigeria.

MATERIALS AND METHODS

Source of Feedstuff:

The feedstuffs used in compounding the experimental diets viz yellow maize, soyabean and groundnut cake were obtained from the New Bussa market. The mineral and vitamin premix were got from a pharmacist shop while the blood for the blood meal was obtained from a freshly killed cow at New-Bussa abattoir. The fish used for the fish meal was cropped from one of the polyculture ponds at the National Institute for Freshwater Fisheries Research, New-Bussa.

Processing of Feedstuff:

Before the experimental feeds were compounded, the feedstuffs were prepared and processed to improve their digestibility and eliminate any anti-nutritional factors and this was by cleaning, boiling and toasting as applicable.

About 40 litres of cow-blood collected from the abattoir was boiled at low heat for about six hours until it solidified. It was then sun-dried for three (3) days. It was then ground, packaged and stored for use.

About four (4) kilograms of soyabean was cleaned, sundried and toasted in an oven at 100°C for 30 minutes to remove protease inhibitors (Eyo, 1990). The soyabean was then dehulled, winnowed, grounded, packaged and stored for use.

Specimens of tilapia caught from one of the production ponds at NIFFR was degutted and descaled. The fish was then boiled for ten (10) minutes and then pressed to remove the water and oil. It was then dried in the oven at 95°C for 11 hours. It was then milled and packaged for use.

Toasted groundnut from which the oil has been extracted was used in making the groundnut cake. The groundnut cake weighing about four (4) kilograms was milled and packaged for use. The various ingredients were then weighed, and thoroughly dry mixed together, then wet mixed with about 400mls of water of 50°C to form the dough. The dough was pelleted and pellets sundried. It was then packaged and dispensed as required.

Experimental set up:

Ten (10) hapas each measuring 1.0x1.0x1.0metres made from mosquito netting materials was used for holding the fish in the pond. The *Clarias anguillaris* used for the experiment were collected from the NIFFR hatchery each with a mean weight of 2.8g. Each of the hapas was stocked with 20 *Clarias anguillaris* fingerlings and suspended with kuralon rope into water in a concrete tank 10x5x1.5m to a level of about 2/3rd of the height of the hapa. The fingerlings were allowed to acclimatize for seven days after which those still surviving were shared ten (10) per hapa. Feeding then commenced after the specimens in each of the hapa had been starved for 48 hours so that they can empty their gastro-intestinal tract. The fingerlings were fed 3% of their body weight twice daily (at 7.30 am and at 5.30 pm). The fish were fed for eight (8) weeks. The weight of the fish was taken bi-weekly and the quantity of feeds adjusted accordingly as weight increased.

Water quality parameters monitored for the ten weeks includes temperature, turbidity, pH and dissolved oxygen. Readings were taken every week usually in the morning before 10.00am. (Table 2). Also records of mortality was taken and recorded

Table 2: Weekly Records of water quality parameters of the concrete tank

Week	Temperature °C	pH	Dissolved oxygen mg/l	Turbidity (m)
0	30.0	7.6	5.0	0.25
1	30.0	7.6	5.0	0.25
2	31.0	7.6	5.0	0.25
3	27.5	7.6	5.0	0.30
4	28.0	7.6	5.0	0.30
5	28.0	7.6	5.0	0.25
6	29.0	7.6	5.0	0.25
7	28.5	7.6	5.0	0.2
8	29.0	7.6	5.0	0.2

accordingly. Proximate analysis was carried out to determine the moisture content, ash and crude protein of the five diets (after AOAC, 1980). Various growth indices were also determined and this includes:

(i) Specific growth rate (SGR) using the formula:

$$SGR = \frac{\text{Log}_e w_2 - \text{log}_e w_1}{T_2 - t_1} \times \frac{100}{1}$$ (after Brown, 1957)

Where w_2 = final wt of fish
w_1 = initial wt of fish
T = period of experiment in days.

(ii) Mean growth rate (MGR) was also calculated using the formula

$$MGR = \frac{w_2 - w_1}{0.5(w_1 + w_2)t} \times \frac{1000}{1}$$

Where t = period of experiment in days
w_2 = final wt
w_1 = initial wt

(iii) Feed conversion ratio (FCR) using the formula

$$FCR = \frac{\text{Total feed given (g)}}{\text{weight gained (g)}}$$ (after Body, 1945)

(iv) Also, protein efficiency ratio (PER) was calculated using the formula:

$$PER = \frac{w_2 - w_1}{P}$$ (after Zeiotoun *et al.*, 1973)

Where P = Protein intake = $\frac{\%\text{protein diet}}{} \times$ Total feed consumed

w_2 = final wt

w_1 = initial wt

RESULT AND DISCUSSION

The composition of the experimental diets is shown in Table 1. While the growth performance of *Clarias anguillaris* fed the experimental diets is shown in Table 3 and also in Figure 1. The best growth rate was recorded among fingerlings fed fish meal as the only protein source (DT5) while Dt2 containing soyabean, groundnut cake (40%), blood meal as the protein sources came next. The growth rate of fingerlings fed Dt2 (40% groundnut cake, 10% soyabean meal and 10% fish meal) was higher than those fed Dt4 containing 10% fish meal but lower than those fed Dt5 which has fish meal as its sole source of protein.

Table 3: Cumulative Bi-weekly Record of weight increment (g) by the experimental fish over the period of the experiment

Diets	Wk1	Wk3	Wk5	Wk7	Wk9
Dt1	2.77	5.31	5.92	6.60	6.98
Dt2	2.84	6.35	7.61	8.84	9.27
Dt3	2.78	5.61	6.84	7.56	8.01
Dt4	2.87	5.86	6.92	8.0	8.94
Dt5	2.85	5.74	7.16	8.73	9.55

Key:

Dt = Experimental diets as fomulated in Table 1.

Wk = Week(s)

The least growth was exhibited by fingerlings fed 10% groundnut cake, 40% soyabean meal and 10% blood meal (DT1).

The higher growth performance exhibited by the fish meal diet was expected since fish meal contain all the essential amino acids needed for fish growth (Lovell, 1981).

Diet containing 40% soyabean meal, 10% groundnut cake and 10% blood meal was poorly utilised by *C. anguillaris* fingerlings. This could be due to imbalance in two plant protein sources. Groundnut cake is low in methionine (UNDP/FAO, 1982) and soyabean meal also has sub-optimal amount of methionine (Nose, 1978). Therefore a mixture of the two plant protein sources would be expected to increase the deficiency of methionine in the diet. Blood meal has a fair amount of methionine although its limiting amino acid is isoleucine. Yellow maize has a fair amount of methionine. Since blood meal and yellow maize were present at the same level in diet 1,2 and 3, the higher growth performance exhibited by diet 2 which contained 40% groundnut cake and 10% soyabean meal should be due to the influence of groundnut cake which was higher in this ration. Earlier studies have shown diet containing groundnut cake as the only protein source to be better than that containing soyabean meal and groundnut cake (Eyo and Adelowo 1991).

Soyabean meal is usually considered the best plant protein source for meeting the essential amino acid requirement of fish (Akiyama, 1988). This is attributed to its amino acid profile and high digestibility. However indications are that soyabean meal does not give a particularly excellent growth to *Clarias anguillaris* fingerlings compared with groundnut cake. It is probable that groundnut cake is more palatable and its protein more utilized by *C. anguillaris* fingerlings than soyabean meal. However from the calculated value of SGR,MGR, FCR and PER Dt5 containing 53% fish meal as its sole protein source was the overall best diet (Table 4).

Table 4: Growth performance of *Clarias anguillaris* fingerlings fed different levels of groundnut cake and soyabean.

	Dt1	Dt2	Dt3	Dt4	Dt5
Initial meal weight	2.77^{a}	2.84^{a}	2.78^{a}	2.87^{a}	2.85^{a}
Final mean weight	6.98	9.27	8.01	8.94	9.55
Mean weight gained	4.21^{a}	6.43^{b}	5.23^{b}	6.07^{c}	6.70^{c}
Specific growth rate (SGR)	0.63^{a}	0.82^{b}	0.70^{b}	0.77^{c}	0.84^{c}
Mean growth rate (MGR)	$1.91x10^{-40}$	$3.4x10^{-46}$	$4.0x10^{-43}$	$1.75x10^{-57}$	$8.04x10^{-47}$
Food Conversion Ratio(FCR)					
Protein efficiency ratio (PER)	3.14^{a}	2.95^{b}	2.90^{b}	3.06^{c}	2.49^{c}
Mortality	1.13^{a}	1.08^{b}	0.98^{b}	0.93^{a}	0.97^{b}
	10%	**5%**	**5%**	**10%**	**10%**

Note: Values in the same horizontal lines followed by the same letters are not significantly different.

SUMMARY AND CONCLUSION

As expected, it was observed in this study that fish fed the fish meal diet gave a higher growth rate than others it came out clearly that feed containing 40% groundnut cake, 10% soyabean meal and 10% blood meal as the protein source was better utilised by *Clarias anguillaris* fingerlings than feed containing 40% soyabean meal, 10% groundnut cake and 10% blood meal. Although protein of soyabean meal appear to be better in terms of the amino acid profile than that of groundnut cake, groundnut cake protein is improved and becomes better utilised by *Clarias anguillaris* fingerlings when mixed with other feedstuffs. The experiment shows that in the diet formulation for *C. anguillaris* fingerlings groundnut cake should be given a higher premium than soyabean meal.

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